Student's Journal of Health Research Africa
e-ISSN: 2709-9997, p-ISSN: 3006-1059
Vol. 5 No. 6 (2024): June 2024 Issue
https://doi.org/10.51168/sjhrafrica.v5i6.1193
Original Article

MORTALITY AND MORBIDITY PROFILE IN ELBW AND VLBW NEONATES IN A TERTIARY CARE SETUP: A RETROSPECTIVE OBSERVATIONAL STUDY

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Abstract

Background

Below 5 years of age globally half of the children are dying in the first month of life. The neonatal period accounts for 2.4 million/annum deaths globally. Low birth weight (< 2500 grams) is often associated with mortality and morbidity. The study analyzed the morbidity and mortality profiles of ELBW and VLBW neonates.

Method

The study was conducted as a retrospective observational study in the Department of Neonatology. Preterm babies with low birth weight were considered for this study. Maternal characteristics and neonatal characteristics were recorded. They were followed up for 28 days from the day of birth. All the complications developed, treatment, and outcomes were recorded during this period.

Results

In this study, 96 neonates with less than 1500 grams of birth weight were studied retrospectively over the last 2 years of data. The mortality rate of ELBW babies was 47.6%, that of VLBW babies excluding ELBW was 8%, and 2 babies were gone for LAMA. The death rate in babies with gestational age in weeks≤24, 25-26, 27-28, 29-32, 33-35, and >35 was 80%, 80%, 16.6%, 1.3%, 14.3%, and 75%, respectively. The most common cause of death in VLBW neonates is sepsis, with pulmonary hemorrhage being 25% each, followed by respiratory distress syndrome, severe intraventricular hemorrhage, and perinatal asphyxia being 18.75%, 18.75%, and 12.5%.

Conclusion

ELBW newborns have a higher probability of mortality and morbidity when associated with other complications such as pulmonary hemorrhage, RDS, and sepsis compared to LBW newborns.

Recommendation

The long-term follow-up done at the NICHD wherein the network is developed so that the tracking of the ELBW infants is assured decreases the mortality significantly. Such tracking networks and follow-up of the ELBW patients are required.

Keywords: *Very low birth weight, Mortality, APGAR, Neonatal death.*
Submitted: *May 31, 2024* ***Accepted****: June 3, 2024*
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Introduction

Below 5 years of age, globally, half of the children are dying in the first month of life. Neonatal period, which accounts for 2.4 million/ annual deaths globally [1]. Low birth weight (< 2500 grams) is often associated with morbidity and mortality. Among the LBWs, very low birth weight (VLBW{<1500 grams}) and extremely low birth weight (ELBW{<1000 grams}) neonates account for around 1% of all live births, yet together they account for half of all neonatal deaths. With obstetrics and neonatal healthcare advancements, more and more premature ELBW and VLBW neonates are coming to the NICU, and problems related to their health are also gradually increasing. In the last 2 decades, the survival rate of premature neonates has gradually increased from 10% to 60% [2]. ELBW survival also improved significantly due to resuscitation in the delivery room, surfactant administration, appropriate respiratory support, and proper monitoring [3]. Still, there is a disparity between developed nations where the health sector is much more advanced than low- or medium-income countries where advanced health facilities are still a distant dream, where mortality in ELBW and VLBW neonates is still a concern, and the morbidity pattern of ELBW is often

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different in developing countries than the developed countries [4].

There is less literature reporting the mortality and morbidity of ELBW neonates from low- and middle-income countries. In India a medium-income country and disparity between region to region economically there is a disparity between health facilities also observed. The reported survival of ELBW and VLBW neonates from these units varied from 40–60% [5–8]. However, there are very few studies that suggest the mortality and morbidity profiles in the economically backward regions of India.

Hence, this study analyzed the morbidity and mortality profiles of ELBW and VLBW neonates in the tertiary care NICU of IMS& SUM Hospital, Bhubaneswar, Odisha, which is one of the poorest states in India.

Method

Study design

A retrospective observational study.

Study setting

The study took place in the Department of Neonatology, IMS & SUM Hospital and College under SOA University, Bhubaneswar, Odisha. The study duration was from March 2023 to June 2024.

Participants

A total of 96 babies with birth weights less than 1500 grams were admitted to our NICU during this study period, and samples were taken from the labor room, postnatal ward, and Neonatal Intensive Care Unit.

Inclusion criteria

All neonates admitted to our NICU were included in the study.

Exclusion criteria

The neonates who were admitted after 28 days of life into the NICU and those with more than 1500 grams of weight were excluded.

Bias

There was a chance that bias would arise when the study first started, but it was avoided by giving all participants identical information and hiding the group allocation from the nurses who collected the data.

Variables

Maternal and neonatal data were collected, including maternal age, parity, risk factors (e.g., sepsis, hypertension), antenatal steroids, and neonatal variables such as gestational age, birth weight, APGAR scores, NICU stay, and complications (e.g., RDS, NEC). Neonates were categorized by birth weight (VLBW, ELBW), with outcomes monitored for 28 days, documenting complications, treatments, and deaths.

Data collection and procedure

Maternal and neonatal data were collected from the medical records of the delivery room, postnatal ward, and NICU. A detailed maternal history of all cases was taken giving due importance to the maternal age, parity, date of last menstrual period, and the expected date of delivery.

Maternal factors like, risk factors for sepsis, pregnancy-induced hypertension, diabetes mellitus, antepartum hemorrhage, meconium-stained amniotic fluid, duration of premature rupture of membrane, and clinical chorioamnionitis, e.g., smelling liquor, were recorded. Any maternal history of fever or UTI within 7 days of delivery was recorded. A history of antenatal steroids (ANS) taken by the mother was noted. Mothers who had completed apart, a full course of ANS i.e. Inj Betamethasone Phosphate12mg 24 hours apart 2 doses or Inj Dexamethasone phosphate 6mg 12 hours apart 4 doses, at least 12 hours before delivery, were taken into account.

Gestational age, birth weight, gender, perinatal events in the labor room, APGAR score at 1 min and 5 min, length of stay in the NICU, respiratory distress syndrome (RDS), and the duration of oxygen administration, non-invasive ventilation, or mechanical ventilation were recorded. Other complications of prematurity like HsPDA, ROP, IVH, NEC, anemia of prematurity requirement of transfusion (PRBC, RDP/SDP, FFP), and osteopenia of prematurity were noted. The requirement of surfactant and the time of administration were recorded.

Babies with weights between 1000 to 1500 were in the VLBW group and those with weights less than 1000 were in the ELBW group. All the neonatal characteristics such as birth history, significant complications, as well as socio-demographic profiles were recorded. They were monitored for 28 days of life. Outcomes such as complications, death, and treatment given were recorded meticulously.

Ethical consideration

Ethical committee approval was obtained. The parents were informed about the study, and written consent was obtained from the parents in the local Odia language. After obtaining written consent from parents, neonates (0–28 days) admitted to the postnatal ward and neonatal intensive care unit (NICU) were selected for the study.

Statistical analysis

The data is expressed in terms of mean and standard deviation. The data between ELBW and VLBW is compared using Fisher's exact test and chi-square test. The odd ratios

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and 95% confidence interval were also measured. The predictors of mortality are p-value, odds ratio, and RR.

Result

In this study, 96 neonates with less than 1500 grams of birth weight were studied retrospectively over the last 2 years of data. The mean birth weight of all infants is 1175.32±235.32 grams, with a mean gestational age of 30.69±3.15 weeks. Out of which, 19 neonates are outborn, and the rest are delivered in our hospital. 38 neonates are less than the 10th percentile of birth weight (SGA), according to the Fenton chart.54 of the neonates have been delivered through the lower segment of the cesarian section (LSCS). M: F sex ratio in the study was 51: 45. Maternal sepsis in our study was found to be 55.2%. The coverage of a completed dose of antenatal steroid was found to be 45.8%, and at least 1 dose of steroid was taken by 27.5% of mothers. During delivery, 7.2% of the babies went into severe perinatal depression with an APGAR score of 5 minutes below 5 (Table no. 1).

Table No. 1: Baseline characteristics

Parameters	N=96	n/N%
Gestation	30.69 ± 3.15	
Birth weight	1175.32±235.32	
Survival	78	81.25
Inborn	77	80.2
IUGR	38	39.6
Male	51	53.1
LSCS	54	56.2
APGAR @ 5 min (perinatal asphyxia)	7 (below 5)	7.2
Maternal sepsis	53	55.2
Antenatal Steroid full	44	45.8
ANS partial	26	27.1

Mortality of ELBW babies was 47.6% and that of VLBW babies excluding ELBW was 8% and 2 babies were gone for LAMA. Death rate in babies with gestational age in weeks≤24, 25-26, 27-28, 29-32,33-35, >35 was 80%, 80%, 16.6%,1.3%,14.3% and 75% respectively (Table 2)

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Table no.2: Gestation-wise and weight-wise survival statistics.

Survival	No of baby(N)	Survived	Mortality(n)	n/N %
Gestation wise ≤ 24 weeks	5	1	4	80
25-26 weeks	5	1	4	80
27-28 weeks	6	5	1	16.6
29-32 weeks	55	53	1(1)	1.3
33-35 weeks	21	17	3 (1)	14.3
>35 weeks	4	1	3	75
Weight wise <500 grams	0	0	0	0
500-999 grams	21	11	10	47.6
1000-1499 grams	75	67	6 (2)	8

The most common cause of death in VLBW neonates is Sepsis, with pulmonary hemorrhage being 25% each followed by Respiratory distress syndrome, severe intraventricular hemorrhage, perinatal asphyxia being 18.75%,18.75%, and 12.5%.

The causes of death in ELBW and VLBW are different. In ELBW common causes of death are mostly associated with causes related to prematurity like RDS, IVH, and pulmonary hemorrhage. In VLBW common cause of death is mostly sepsis and perinatal asphyxia (Table no.3).

Table no.3: Different causative factors in ELBW and VLBW babies.

Cause of death	500-999grams	>1000grams	Total	Percentage (%)
RDS	2	1	3	18.75%
SEPSIS	0	4	4	25%
PERINATAL ASPHYXIA	1	1	2	12.5%
PULMONARY HEMORRHAGE	4	0	4	25%
INTRAVENTRICULAR HEMORRHAGE	3	0	3	18.75%

There was no significant difference between morbidities like RDS, Shock, Sepsis clinical or culture positive, Perinatal asphyxia, IVH, PVL, NEC, neonatal hyperbilirubinemia(NNH), Sezure, PDA, ROP, Osteopenia of prematurity, air leak, BPD between ELBW and VLBW neonate.

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Table no.4: Differences in different morbidities in ELBW and VLBW babies.

MORBIDITY	ELBW (n=21)	VLBW (n=96)	P Value
RDS	16 (0.66)	46 (0.48)	0.91
SHOCK	11 (0.53)	21 (0.22)	0.81
Perinatal asphyxia	7 (0.33)	10 (0.1)	0.8
SEPSIS	20 (0.95)	71 (0.74)	0.92
Culture positive Sepsis	7 (0.33)	25 (0.26)	0.95
NNH	10 (0.48)	62 (0.65)	0.93
IVH	8 (0.38)	19 (0.2)	0.87
Severe IVH	3 (0.14)	4 (0.04)	0.86
PVL	2 (0.095)	4 (0.04)	0.92
TOP	7 (0.33)	18 (0.19)	0.9
OSTEOPENIA OF PREMATURITY	6 (0.29)	19 (0.2)	0.93
SEIZURE	3 (0.14)	5 (0.05)	0.89
BPD	5 (0.24)	6 (0.06)	0.8
PDA	4 (0.19)	9 (0.093)	0.9
NEC	1 (0.047)	5 (0.05)	0.99
Air leak	3 (0.14)	5 (0.05)	0.88

Several neonates affected with clinical sepsis and culture-positive sepsis were found more in VLBW neonates than ELBW neonates.

When different morbidities were compared between expired and survival groups, it was observed that odd ratios were higher in expired patients with shock, PDA, acute renal failure(ARF), and pneumothorax. The shock had the highest odd's ratio of 180.000 suggestive of a significant impact on mortality followed by pneumothorax, ARF, perinatal asphyxia, PDA, and RDS with odd's ratios of 25.667,25.667, 19.444, 15.000, 4.091 respectively (Table no. 5).

Table no. 5: Relative risk of various morbidities in expired and survived neonates

MORBIDITY	EXPIRED (n=16)	SURVIVED (n=78)	ODDS RATIO	95% CI	P value
RDS	12	33	4.091	1.211-13.822	0.017
CULTURE POSITIVE SEPSIS	6	17	2.153	0.684-6.772	0.000
SHOCK	15	6	180.000	20.168-1606.522	0.000
PERINATAL ASPHYXIA	7	3	19.444	4.257-88.814	0.000
IVH	7	10	5.289	1.609-17.386	0.003
NEC	1	4	1.233	0.129-11.825	0.857
PDA	6	3	15.000	3.232-69.617	0.000
PNEUMOTHORAX	4	1	25.667	2.641-249.475	0.000
ARF	4	1	25.667	2.641-249.475	0.000

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Discussion

In this study, 96 newborns with low birth weights were analyzed for treatment and outcome at the tertiary care center in Odisha. Overall survival was 81.25% with inborn delivery being 80.2 %. The most common cause of mortality is sepsis and pulmonary hemorrhage followed by respiratory distress syndrome and severe intraventricular hemorrhage followed by perinatal asphyxia. In birth weight, less than 1000 grams, the presence of shock, necrotizing enterocolitis, and hemodynamically significant patent ductus arterioles increased the occurrence of death. The survival in this study was much lower compared to the other studies conducted internationally, osteopenia of prematurity, and bronchopulmonary dysplasia were almost similar in proportion to other studies [9-13]

In our study, 39.6% of VLBW neonates were SGA, which was less than the national prevalence of 46.9% [14]. The small gestational age is prevalent in the range of 20 to 60% in India [6,8,15]. The small gestational age of the newborns is due to maternal characteristics such as lack of nutrition, genetic factors, and due to high-risk pregnancy in most of the cases. Intrauterine growth restriction is a factor that also contributes to small gestational age [16,17].

The mortality associated with babies with a weight more than 1000 grams is 8% whereas, the mortality in the case of newborns with a weight less than 1000 grams is 47.5%. According to a decade's data of from UCSF, the survival of newborns with a weight between 500 to 700 grams is 74%, those with a weight between 751 to 1000 grams had a survival rate of 82%, those with a weight between 1000 to 1200 grams had a survival rate of 92%, and those with a weight between 1200-1500 gram had a survival rate of 95% [18]. Survival rate varies in patients according to the region of the center [6-8]. 73.75% of VLBW newborns survived and 39.8% of the ELBW newborns survived in this study. Another research at AIMS found the survival rate of VLBW of 84% and ELBW [19] Yet another study at PGIMER found that newborns with ELBW had a survival rate of 48%.[20] The survival rate varies in different centers due to differences in terms of the technology and patient care provided during the antenatal, intranasal, postnatal, and neonatal phases. As well as the availability of sophisticated neonatal intensive care units. Here the data is collected from the tertiary care set-ups with the best facilities available. Still, the difference in the survival of lower birth weight groups is due to the immaturity of the physiological systems. In this study, similar to other studies ELBW patients had a much lesser survival rate compared to VLBW patients.

Sepsis and pulmonary hemorrhage were the primary causes of death in both ELBW and VLBW groups of babies accounting for 25% of all causes of death each. Respiratory distress syndrome, Severe intra-ventricular hemorrhage, and perinatal asphyxia were the next common causes of death accounting for 18.75%,18.75%, and 12.5% of all deaths. A study conducted at Chandigarh PGIMER showed that of a newborn who died with ELBW 46% of them had sepsis, 20% of them had pulmonary asphyxia, and 19 % of them had a hemorrhage in the pulmonary region [8] NICHDNRN reported RDS in 93% of the ELBW newborns [18]. In a single-center study from a tertiary care hospital with 212 VLBW neonates from south Odisha T Saroj et al found that RDS caused the death of 37% of VLBW and ELBW newborns [21]. Sepsis and HIE were reported to be the cause of death in 34% and 13% of the patients. However, the findings of our study were contradictory to these findings. Due to resuscitation in the labor room, proper golden hour management and use of surfactant and early CPAP use might have reduced mortality due to Perinatal asphyxia and RDS.

The occurrence of RDS was higher in ELBW newborns by 28% compared to VLBW. Similarly, another study found that ELBW newborns died due to RDS 28% more than VLBW patients [8]. RDS is higher amongst the ELBW due to the immature lungs and lower production of surfactant. The incidence of culture-positive sepsis was 33% in ELBW babies and VLBW babies 26% which was insignificant. Pulmonary complications and sepsis are reported higher in ELBW than in VLBW in past studies [8,15]. Impaired defense mechanisms and immunity along with immature physiological organs such as lungs in case ELBW patients have a high impact on their survival rate.

Comparing the findings with the international findings, especially in the case of developed nations. The occurrence of bronchopulmonary dysplasia is higher in our study, this could be explained by the fact that there was suboptimal use of oxygen ventilation and the occurrence of sepsis. In this study, the newborn's cohort was inclined towards a much smaller gestational age comparatively. Also, the incidence of BPD was much higher in cases of VLBW newborns than of ELBW newborns this could be explained by the low survival rate of ELBW newborns. Moreover, the occurrence of enterocolitis and retinopathy of prematurity which required photocoagulation was similar in proportion as compared to the rest of the world. Good surgical practice and maintenance of optimum oxygen saturation levels prevented such occurrences. Also, breast milk feeding helped in preventing the occurrence of enterocolitis. The incidences of fungal sepsis were comparatively lesser in this study [17,22].

Generalizability

The study's findings on the major causes of death in VLBW neonates, such as sepsis and pulmonary hemorrhage, can guide healthcare providers in prioritizing interventions and improving neonatal care. However, differences in healthcare

practices and regional factors must be considered for these findings to be effectively applied to larger populations. Standardized care protocols and enhanced infection control measures are recommended to reduce mortality and morbidity rates.

Conclusion

ELBW newborns have a higher probability of mortality and morbidity when associated with other complications such as pulmonary hemorrhage, RDS, and sepsis compared to LBW newborns. Mortality in newborns can be prevented by improving the existing protocols of newborn care at the national level.

Limitation

This study was a single institutional study so the data cannot be extrapolated to the other regions of the country. Thus, multiple institute study is required to confirm the findings of this study. Also, the management of certain newborn infants with extremely low birth weight was not attainable due to financial constraints.

Recommendation

The long-term follow-up done at the NICHD wherein the network is developed so that the tracking of the ELBW infants is assured decreases the mortality significantly. Such tracking networks and follow-up of the ELBW patients are required.

Acknowledgment

We are thankful to the staff and volunteers of the study for their kind cooperation throughout the study duration.

List of abbreviation

LBW- Low Birth Weight
VLBW- Very Low Birth Weight
ELBW- Extremely Low Birth Weight
NICU- Neonatal Intensive Care Unit
APGAR- Appearance, Pulse, Grimace, Activity, and Respiration
RDS- Respiratory Distress Syndrome
IVH- Intraventricular hemorrhage,
NEC- National Electrical Code
LSCS- Lower segment cesarean section
LAMA- leaving against medical advice
BPD- Bronchopulmonary dysplasia
NNH- Neonatal hyperbilirubinemia
HIE- Hypoxic Ischemic Encephalopathy

Source of funding

No funding received.

Conflict of interest

The authors declare no conflict of interest.

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